BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In the Matter of:	)	
	)	
Redevelopment of Spectrum	)	ET Docket No. 92-9
to Encourage Innovation	)	
in the Use of New	)	
Telecommunications Technologies	)	

TO: The Commission

COMMENTS OF ASSOCIATED PCN COMPANY

Associated PCN Company ("APCN"), by its attorneys, herein comments on certain of the proposals contained in the Notice of Proposed Rulemaking ("Notice") released in the above-captioned docket on February 7, 1992. Specifically, APCN will comment on the Commission's proposals to relocate existing users in the 1.85 to 2.20 GHz band in order to provide spectrum for new technologies.

Summary

New technologies, such as PCS, can be accommodated in the 2 GHz band without displacing incumbent users through the introduction and use of proven spectrum sharing techniques. APCN has demonstrated that even in the most heavily congested markets there is sufficient spectrum to fully deploy new PCS systems without relocating existing users. The Commission must

consider this situation very carefully because the costs and difficulty of relocation far exceed the estimates contained in the staff study.

Introduction

APCN is a partnership between Associated PCN Corporation, a wholly-owned tier subsidiary of Associated Communications Corporation ("ACC") and LCC, Incorporated ("LCC"), a premier telecommunications consulting firm specializing in providing 1) cellular engineering consulting services, 2) specialized software for telecommunications system analysis, and 3) sophisticated equipment for field measurement testing for over 200 cellular system operators in the U.S. and Europe. LCC has over 250 full time staff over 60% of which are engineers. ACC, through its subsidiaries and affiliates, is a licensee in the DPCRTS, common carrier point-to-point microwave radio service, broadcast radio service, domestic satellite radio service, experimental radio service and private land mobile radio services. LCC is well known and respected for its consulting engineering and other technical services in the land mobile radio industries as well as other industries which utilize radio-based technologies. It has also developed computer software which is widely used by cellular communications systems and other land mobile operations to more accurately predict radio propagation and measure signal strength. Indeed, APCN has applied LCC's expertise to the development of personal

communications networks through the use of customized tools. Thus, APCN represents a unique blend of expertise and experience which is highly relevant to the development of emerging wireless technologies and the potential for sharing of currently allocated spectrum.

APCN holds authorizations from the Commission to conduct experiments related to personal communications services ("PCS") in the Los Angeles, New York, Chicago and Washington, D.C. areas. It has been conducting PCS experiments in its Los Angeles test bed since being issued the authorization on January 7, 1991. Prior to that date, APCN conducted preliminary propagation testing in Los Angeles pursuant to Special Temporary Authority issued in October, 1990. APCN has submitted to the Commission six quarterly reports which detail the progress and findings of its PCS experiments in Los Angeles. The authorizations for the New York, Chicago and Washington, D.C. PCS experiments were issued on March 16, 1992 and the test beds for those experiments are in the process of being developed. On August 13, 1991, APCN filed a request for a Pioneer's Preference in connection with any future licensing of PCS by the Commission. That request was the subject of public comment in response to a Commission Public Notice and was supplemented by APCN on May 4, 1992.

Relocation Of Existing Users Is Unnecessary

In the Notice, the Commission "proposes to establish new areas of the spectrum to be used for emerging telecommunications

technologies." As the Commission defines its task in the Notice, it is "to identify a relatively wide band of frequencies that can be made available with a minimum of impact on existing users and that also can provide suitable operating characteristics for new, primarily mobile, services." Based on the findings of a staff study, the Commission proposes to designate 220 MHz of the spectrum between 1.85 and 2.20 GHz for these emerging telecommunications technologies. This spectrum is currently allocated to and used by fixed private and common carrier microwave services, public land mobile service, broadcast auxiliary operations and multipoint distribution service. Having identified the spectrum to be used, the Commission proposes both short and long range procedures for the relocation of existing users of that spectrum. The Notice does not address whether state-of-the-art commercial and developmental technology would allow spectrum sharing without any need for relocation of existing users. APCN submits that the relocation proposals are premature and ultimately unnecessary.

Throughout APCN's filings in the PCS proceeding, its applications for experimental PCS authorizations, its quarterly reports and its request for a Pioneer's Preference, APCN has consistently advocated the sharing of currently allocated spectrum instead of forcing current users of the spectrum to relocate their operations to another portion of the spectrum or to use other technologies such as fiber optics or coaxial cable.

APCN submits that the Commission's objective of a "minimum of impact on existing users" would best be served by the sharing of spectrum between emerging telecommunications technologies and existing users so that no relocation would be required. However, the Commission appears to have rejected spectrum-sharing as an overall solution to finding spectrum for these new technologies without exploring the potential of spectrum sharing techniques such as narrowband spread spectrum. While it is true that the 2 GHz band may appear to be heavily used to an entity seeking to coordinate fixed microwave facilities, it may nonetheless appear to be lightly used to an entity seeking shared spectrum for PCS facilities.

Despite its focus on the relocation of existing users, the Commission proposes "to allow currently licensed 2 GHz fixed licensees to continue to occupy 2 GHz frequencies on a co-primary basis with new services for a fixed period of time, for example, ten or fifteen years." The Commission further proposes to allow state and local government 2 GHz fixed microwave facilities "to continue to operate at 2 GHz on a co-primary basis indefinitely, at the discretion of the state and local government licensees." It is unclear why the Commission seems ready to accept spectrum-sharing as technically feasible in these particular contexts but not in general. If the Commission is of the view that spectrum-sharing is not technically feasible, then it is unclear why the Commission makes these spectrum-sharing proposals. In the Los Angeles

area, forty (40) percent of all duplex 2 GHz fixed microwave paths are licensed to state or local government entities. The Commission must believe that emerging telecommunications technologies will incorporate a method for avoiding interference to the existing users of the subject spectrum. Since permanent spectrum sharing with state and local government 2 GHz fixed microwave facilities is acceptable, it should also be acceptable in the case of non-government facilities.

The technology that APCN has developed and is in the process of testing and perfecting does not require relocation of incumbent users of the spectrum. As explained in detail in its request for a Pioneer's Preference and its quarterly reports, the technology used by APCN enables a PCS system operator to avoid the frequencies used by existing licensees and to adjust to and accommodate the frequencies used by new licensees of the shared spectrum. APCN's technology uses a technical design that incorporates direct sequence spread spectrum, frequency hopping and sophisticated frequency management. APCN divides the band of spectrum into 5 MHz channels, using frequency management techniques to increase capacity and reduce interference to existing fixed service providers. A four-cell re-use pattern is used to minimize the effects of intercell interference. Each 5 MHz channel will be modulated using direct sequence spread spectrum and code division multiple access. Since the signal will be spread across a 5 MHz band, the radiation being emitted will be of a non-interfering nature relative to microwave

carriers on the same band. Also, mobile subscribers on the same band will not interfere with one another. Frequency hopping and mobile-assisted handoff are integral and key portions of the APCN approach. The APCN frequency hopping process allows the system to dynamically modify its frequency hopping topology to order to manage interference. APCN proposes to refine the frequency hop process by basing it on Bit Error Rate, received signal strength, location, and interference. Sophisticated software in the APCN base stations and in the users' portable units can select frequencies that are not in use by a fixed microwave system within the service area of a particular microcell. As part of its August 13, 1991 request for a Pioneer's Preference, APCN submitted detailed frequency maps of the Los Angeles, CA area which indicate the existence of sufficient available spectrum in the 1.85 to 1.99 GHz band to accommodate two PCS providers on a spectrum-shared basis without either relocating any existing users or impairing their ability to satisfy future growth needs.

The Commission's relocation proposal is also premature because even if relocation proves to be necessary, it does not satisfactorily identify new "homes" for the existing users. The Commission merely states that other locations in the spectrum or different non-radio technologies exist. The Commission should be very careful not to engage in "band clearing" without carefully considering the costs of relocation and the current and future growth needs of the existing 2 GHz users.

The Commission staff study dramatically understates the costs of relocation to the existing 2 GHz user. That study found that the cost of 2 GHz equipment to be replaced would range from $62,500 (private fixed microwave) or $83,000 (common carrier fixed microwave) if relocation were to be immediate to $0 if relocation were to occur after the end of the equipment life cycle. The study further found that the cost of conversion to frequency bands above 3 GHz would be approximately $25,000 (including frequency coordination, antenna upgrades, improvement to antenna structures and other relocation costs). Thus, according to the staff study, the cost of relocation for an existing user would range from $25,000 to $108,000 depending on the timing of the relocation and the remaining useful life of the equipment. In contrast, a Telecommunications Design Services, Inc. ("TDSI") study commissioned by APCN and appended hereto as Exhibit A finds that the minimum (without land leases, towers, roads or power) estimated cost per microwave path upgrade from a 24 channel low capacity analog radio system in the 2 GHz band to a single T1 line digital configuration of a wideband 6 GHz microwave radio system would be $286,000. Given the 29-30,000 existing 2 GHz facilities, the total relocation cost as calculated by the TDSI study is several billion dollars more than estimated by the Commission staff study.

Another relocation cost factor not considered by the Commission staff study stems from its failure to recognize that in many instances 2 GHz frequency band users with long microwave

hops, if forced to relocate at higher frequencies, may have to shorten their microwave paths by adding intermediate repeater sites. As a result, it may be necessary to have two such paths to replace a single 2 GHz path. The associated increase in relocation cost could easily double the $286,000 estimate. This issue is discussed in detail in a second TDSI study, appended hereto as Exhibit B, which addresses a recent Comsearch study entitled "Exploring Alternate Bands for 1.9 GHz Systems: A Frequency Coordination Case Study" presented at ENTELEC '92 in Houston, Texas.1/ Like the Comsearch study, the Commission staff study does not address the spectral inefficiencies of having low capacity users vying for the same frequencies as high capacity users which would result from the varying bandwidth requirements of the relocated users. Nor does either study consider the impact of relocation on the future growth needs of the other users already licensed within the band in which the relocation is to occur.

The Commission proposes to "allow providers of new services assigned spectrum allocated to the new emerging technologies bands to negotiate financial arrangements with existing

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1/ The Comsearch study addresses the relocation of existing private fixed microwave users of the 1.85 to 1.99 GHz band to the 6.7 GHz band in order to make room for the emerging telecommunications technologies. The usefulness of this study is undermined because it considers only the private fixed microwave users (omitting common carrier fixed microwave users) and then only in the 1.85 to 1.99 GHz band.

licensees." Given the Commission's "principal desire" to "compensate existing 2 GHz users for the costs of relocation," the Commission's unguided reliance on market negotiations is too vague and ambiguous. The haphazard nature of such negotiations combined with the forced nature of the relocation is too unreliable a basis for the full scale introduction of the type of new services and technologies contemplated by the Commission.

Finally, the Commission's proposal to relocate existing users is premature in light of NTIA's ongoing efforts to identify federal government spectrum for conversion to non-government spectrum and related legislative initiatives. At the very least, any action taken in this docket with respect to the forced relocation of existing non-government users should be made contingent on the availability of federal government spectrum. While it is true that the spectrum proposed in this docket can be made available without some of the delays that would result from the proposal to make federal government spectrum available, the transition process proposed by the Commission may even be lengthier, in part because of the much heavier usage of the non-government spectrum. In this regard, the Utilities Telecommunications Council has suggested that existing users be relocated to the 1.7 to 1.85 GHz band assuming that this band is reallocated from the federal government. APCN submits that relocation should not even be an issue if spectrum is made available from the federal government.

In sum, should the Commission choose to proceed with its proposed reallocation of existing users, it will have chosen to ignore technologies that can provide real efficiencies through spectrum sharing in favor of merely realigning or shuffling the existing users.

Respectfully submitted,

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EXHIBIT A

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TECHNICAL RESPONSE TO THE FCC DOCUMENT

"CREATING NEW TECHNOLOGY BANDS FOR EMERGING TELECOMMUNICATIONS TECHNOLOGY"

FOR

APCN OF LOS ANGELES

APRIL 29, 1992

A TECHNICAL RESPONSE TO THE FCC DOCUMENT

"CREATING NEW TECHNOLOGY BANDS FOR EMERGING TELECOMMUNICATIONS TECHNOLOGY"

The leadership position the United States of America has enjoyed in the telecommunications industry over the last fifty fears is unparalleled in the history of the world. Never has a nation adopted a set of working standards and implemented them with such fervor as we have. This is, in part, due to the efforts of the Federal Communications Commission and their regulation of equipment and frequencies used for 2-way mobile communications, the broadcast industry, the satellite industry and industrial and common carrier microwave users.

The Federal Communications Commission (FCC) has established rules and guidelines to be followed for the development of hardware operated within the available radio spectrums. These guidelines include not only the operating characteristics of the hardware but the management of the radio spectrum. It is through this management effort itself that radio users have been able to plan and execute orderly growth of new radio systems that minimize, if not eliminate, potential signal interference from other carriers.

The FCC has recently published a document, "CREATING NEW TECHNOLOGY BANDS FOR EMERGING TELECOMMUNICATIONS TECHNOLOGY", in which it has expressed a desire to move existing microwave users operating between 1.85 and 2.20 GHz into other frequency bands. This move will provide 220 mHz of bandwidth for new emerging technologies discussed in their published document. Their recommendation is to assign the existing users to the 4 GHz and 6 GHz frequency bands where similar traffic usage is now assigned.

Although the FCC document addresses many of the issues involved with moving the industrial and common carrier users from the 2 GHz frequency band, there are several very real concerns with their plan.

The FCC has stated the increased antenna gain at the higher frequencies will offset the increased Free Space Loss expected in the higher frequency bands. This means a given 6 GHz microwave radio with the same transmit power and receiver sensitivity as a 2 GHz radio will have the same nominal receive signal level and fade margin in either frequency band. Except for minor differences in the transmission line used in each frequency band, this will hold true in the majority of cases.

The operational differences between the 2 GHz and 6 GHz frequency bands manifests itself in the performance expected in each of the bands. The following tables indicate the expected multipath availability of a 2 GHz and 6 GHz microwave path over 17 and 39 miles.

17 MILE MICROWAVE PATH

FM	1.9 GHZ	6.7 GHZ
20DB	99.99599%	99.98581%
25DB	99.99873%	99.99551%
30DB	99.99960%	99.99858%
35DB	99.99987%	99.99955%
40DB	99.99996%	99.99985%
45DB	>99.99999%	99.99996%

39 MILE MICROWAVE PATH

FM	1.9 GHZ	6.7 GHZ
20DB	99.92956%	99.75067%
25DB	99.97772%	99.92116%
30DB	99.99296%	99.97507%
35DB	99.99777%	99.99212%
40DB	99.99930%	99.99751%
45DB	99.99978%	99.99921%

These path lengths were identified by the FCC as the average path length of a 2 GHz microwave path (17 miles) in the Houston area and the path length under which 90% of all 2 GHz paths fall (39 miles).

As can be seen, in each case an additional five to ten dB of path gain will be required at 6 GHz to achieve similar multipath availability. The most common method of increasing this path gain is to increase the size of the antennas at each site. This effectively means increasing the size of an antenna from six (6) foot to ten (10) foot or from eight (8) foot to twelve (12) foot or from ten (10) foot to fifteen (15) foot at each site.

The cost of increasing the antenna sizes at 6 GHz to achieve the required availability can be quite high since many of the existing 2 GHz microwave paths are presently using low cost grid antennas and their 6 GHz counterparts will probably require high performance antennas. The following table indicates the average price of a high performance 6 GHz microwave antenna and mount.

6 GHZ ANTENNA PRICING

ANTENNA SIZE	PRICE
6	$6290
8	$7770
10	$10290
12	$14010
15	$23490

As can be seen in the above table, the cost of increasing the antenna size can be an expensive issue without even considering the effect on the tower structure loading. If an antenna must be increased in size, a full tower structrual analysis must also be performed to determine the expected cost of modifying the tower to support this new antenna.

An alternative to increasing the antenna size in many situations will be to use space diversity receivers on the microwave path to increase the multipath availability. This alternative may reduce the actual size of antenna required at each site but will also require two (2) receive antennas at each site rather than one. This additional antenna loading on the microwave tower may require modifications be made to the tower to eliminate loading problems. The cost of these modifications cannot be estimated but may be as simple as adding new bracing or as complicated as replacing the tower completely.

If it is not possible to increase the antenna sizes or add space diversity antennas on these microwave paths, users may be required to add intermediate microwave sites to achieve the required path and system availability they are now realizing in the 2 GHz frequency band. The additional cost involved with a new intermediate microwave site can include new buildings, roads, power, radio equipment, antennas and towers that can exceed $400,000.00 per site.

The FCC is recommending the move from the 2 GHz frequency band to the 6 GHz frequency band for all private industrial (part 94) and common carriers (part 21) users because like service is now carried in the 6 GHz bands. Although like services exist in this frequency band, the effective utilization of the band will be quite different than the 2 GHz band.

The 2 GHz frequency band allows various bandwidths for the transmission of radio traffic. These include 800 kHz, 1600 kHz, 5 MHz and 10 MHz bandwidths that can support between 24 and 672 channels of voice traffic in an orderly growth pattern. Although these same bandwidths exist in the present 6 GHz industrial frequency band, insufficient channel assignments exist to support all of these 2 GHz channels. This may require low capacity 2 GHz radio channels to be assigned 30 mHz bandwidth channels that can support up to 2400 voice channels in the 6 GHz common carrier band.

Under this FCC plan, existing 2 GHz common carrier channels that only require a few voice channels of traffic will be assigned a full 6 GHz channel thus limiting the use and growth of the frequency band for other potential users in the area. That is, a 24 voice channel user will be assigned the bandwidth normally used by a user requiring up to 2400 voice channels. This is a 100:1 underutilization of the channelization plan now in effect.

Although the FCC report addresses the fact sufficient channel assignments appear to be available in the 6 GHz frequency band to handle the present 2 GHz users, no mention is made of the bandwidth underutilization issue. Nor is there any mention of the disposition of 6 GHz satellite up links now occupying this band.

Moving the existing 2 GHz users into the 6 GHz frequency bands will overcrowd the 6 GHz band with underutilized radio channels and block legitimate growth channels for all users.

The FCC document offers an alternative to the 6 GHz frequency band as a possible solution. This alternative is the existing 4 GHz frequency band which is presently being used by common carriers and satellite companies. Although it is true some of the 2 GHz frequencies can be relocated to the 4 GHz band, it can not be accomplished without great disruption of existing satellite service to a great number of users. The 4 GHz frequency band is presently being used as the down link for satellite services used by such companies as ABC, NBC, CBS, CNN, HBO, TDC, Showtime, Cinamax and others. These services are being viewed by hotel chains such as Holiday Inn, Hilton Hotels, Sheraton Hotels, Hyatt Hotels and many others not to mention the thousands of residential users across the United States. Assignments of the present 2 GHz users to the 4 GHz frequency band cannot be routinely made without effecting the entire broadcast television market and thousands of individual American citizens.

If the present 2 GHz users are required to move the 4 GHz or 6 GHz frequency bands, the move will not be as simple as changing the active radio equipment. As shown earlier, the antenna system may require upgrading as-well-as the towers and foundations. However, the most drastic change in the reassignment of frequencies will come in the replacement of the channelization equipment. The majority of 2 GHz users are presently using analog transmission equipment that may require full replacement to digital technology. This requires that not only the microwave radio be replaced, but the voice/data channel banks and associated equipment. This change of channel bank equipment will average between $5000 and $7000 per terminal location per 24 voice channels.

The FCC document also makes reference to the use of other methods of transmission between the existing microwave site such as fiber optics and VSAT satellites. This statement is analogous to the everyday automobile driver using helicopters and space ships to commute to work. In theory it will work but it is very expensive and not very practical.

Considering the average microwave path length at 2 GHz is 17 miles, the FCC estimated cost of $40,000 per mile of fiber optics cost equates to a $680,000 replacement cost for the average microwave system. This price assumes the user can obtain the required permits and right-of-way to construct such a system. Although fiber optics is an option for many high volume long distance carriers, its practicality falls short for most low capacity short haul users.

VSAT satellite systems, although a possible option for some of the 2 GHz users, are limited in the number of voice and data channels they can carry because of the limited bandwidth. A full satellite terminal can be installed to handle higher capacity users, but estimating the cost of such a system is even beyond the scope of this paper.

The attached **"Project Cost Analysis"** sheet indicates the estimated cost of upgrading a single microwave path from the 2 GHz frequency band to the 6 GHz frequency band. The move is from a 24 channel low capacity analog radio system to a single T1 line digital configuration of a wideband 6 GHz microwave radio. This upgrade assumes sufficient room is available in the existing equipment building to add the required equipment and no tower modifications or replacement is required. As a minimum, without land leases, buildings, towers, roads or power, the estimated cost per microwave path upgrade is $286,000.

The FCC has identified a total of 29116 existing industrial and common carrier facilities that will require upgrade from the 2 GHz frequency band to the 6 GHz frequency band. The estimated cost of upgrading these facilities based upon the dollar amount shown above is $8,327,176,000.00. This cost figure does not include the addition of new intermediate microwave repeater sites which may be required or structural modifications to existing towers.

If the United States of America intends to maintain its position as a world leader in telecommunications services and equipment, it will be necessary for the FCC and the communications industry to develop a cohesive plan for emerging technologies. While this plan must investigate all potential methods of technology development, it must also be consistent with current technology and usage. Transmission methods exist today which allow the coexistence of present and future technologies in the same frequency bands. This frequency band sharing will allow ample frequency growth for all users with a minimum of service disruption and cost.

APCN OF LOS ANGELES
PROJECT COST ANALYSIS
Apr 24, 1992

DIRECT EQUIPMENT REPLACEMENT

SITE NAME==========>		AAAAAA		BBBBBB	TOTAL
ITEMS:	QTY		QTY		
TELECOMMUNICATIONS ENGINEERING	1	$1,250	1	$1,250	$2,500
CONSTRUCTION ENGINEERING	1	$3,750	0	$3,750	$7,500
PROGRAM MANAGEMENT	1	$2,500	1	$2,500	$5,000
CONSULTANTS	1	$2,167	1	$2,167	$4,333
FREQUENCY COORDINATION	1	$1,250	1	$1,250	$2,500
LEGAL SERVICES	1	$1,875	1	$1,875	$3,750
LICENSE FEES	1	$250	1	$250	$500
SITE CONSTRUCTION/INSTALLATION	1	$32,109	1	$32,109	$64,219
SUB-TOTAL		$45,151		$45,151	$90,302
6 GHZ MICROWAVE RADIO TERMINAL	1	$57,500	1	$57,500	$115,000
6 GHZ MICROWAVE RADIO REPEATER	0	$0	0	$0	$0
SERVICE CHANNEL & SUPERVISORY	1	$2,500	1	$2,500	$5,000
T1 CHANNEL BANK	1	$5,000	1	$5,000	$10,000
ENGINEERING & INST. MTL.	1	$3,400	1	$3,400	$6,800
SPARE PARTS & ACCESSORIES	1	$8,778	1	$8,778	$17,557
SUB-TOTAL		$77,178		$77,178	$154,357
POWER PLANT & DIST PNL	0	$0	0	$0	$0
BATTERY RACK (8 HR.)	0	$0	0	$0	$0
STANDBY GENERATOR	0	$0	0	$0	$0
SUB-TOTAL		$0		$0	$0
PARABOLIC ANTENNAS	1	$10,200	1	$14,200	$24,400
SUB-TOTAL		$10,200		$14,200	$24,400
WAVEGUIDE	50	$750	50	$750	$1,500
TUNED CONNECTORS	1	$420	1	$420	$840
PREASSURE WINDOW	2	$76	2	$76	$152
DEHYDRATIOR	1	$3,271	1	$3,271	$6,542
HANGER BRACKETS KITS	1	$295	1	$295	$590
WAVEGUIDE GROUNDING KITS	1	$100	1	$100	$200
SUB-TOTAL		$4,912		$4,912	$9,824
RELAY RACK	1	$301	1	$301	$602
DSX CROSS-CONNECT PANEL	2	$3,000	2	$3,000	$6,000
SUB-TOTAL		$3,301		$3,301	$6,602
BUILDINGS	0	$0	0	$0	$0
TOWERS (INSTALLED)	0	$0	0	$0	$0
ANTENNA MOUNTS	1	$312	1	$312	$624
SUB- TOTAL		$312		$312	$624
INSTALLED SYSTEM COST		$141,054		$145,054	$286,109

EXHIBIT B

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FREQUENCY COORDINATION STUDY

FOR

APCN OF LOS ANGELES

APRIL 10. 1992

PERSONAL COMMUNICATIONS NETWORKS

COMSEARCH CASE STUDY

The Comsearch study, Exploring Alternate Bands for 1.9 gHz Systems: A Frequency Coordination Case Study, presented at ENTELEC'92 in Houston in early April of 1992, addresses the issue of making the frequency spectrum from 1850 to 1990 mHz available for "Emerging Telecommunications Technology". This is to be accomplished by moving current users in this frequency band to the 6.7 gHz industrial frequency band. Their analysis of the bands mentioned indicates that in the Houston area, 103 of 107 users will be able to move from the 1850 to 1990 mHz frequency band to the proposed 6.7 gHz frequency band with no increased frequency interference. No recommendations are made for the four (4) users who can not be moved.

Although at first glance this approach seems to ease the solution to the question of how to handle frequency band assignments for the new "Emerging Telecommunications Technologies", several important questions and points of interest remain.

A. The Comsearch study only addresses the Part 94 Industrial users within the frequency range of 1850 to 1990 mHz while the overall band recommended by the FCC includes 1850 to 2200 mHz. A like number of users are presently utilizing the frequency bands from 1910 to 2200 mHz and no mention is made of their requirement to move to other frequency bands.

   These additional users include other Part 94 industrial users as-well-as Part 21 common carrier such as telephone companies, cellular telephone companies, Other Common Carriers (OCC's) and regional common carriers.

B. The bandwidth requirements of the individual users in the 1850 to 2200 mHz band range from 800F9 users with less than 24 analog voice circuits to full 10000A9Y users with 672 digital voice channels. If these users are assigned frequencies in other bands, their utilization of the band will vary greatly thus allowing low capacity users to vie for radio frequency channels which could be allocated to higher capacity users.

   The microwave radios presently being used by the majority of users in the 1.9 gHz frequency band are low capacity analog radios. The present technology of microwave transmission dictates these users will have to move to digital technology which requires not only a replacement of their radio equipment but their multiplexers and channelization equipment as well.

C. As users are moved from the 1.9 gHz frequency band to the 6.7 gHz frequency band, the number of available frequencies in the 6.7 gHz band is reduced, thus restricting *normal* growth within the band from other users who require the frequencies. Although many users can be physically moved from the 1.9 gHz band to 6.7 gHz, how will future growth requirements be handled?

D. Outside the defined Houston area, many 1.9 gHz frequency band users are operating their microwave paths over long distances. Many of these microwave paths exceed fifty (50) to sixty (60) miles in length and carry narrow bandwidth analog traffic. The technical requirement of placing these users in the 6.7 gHz frequency band go far beyond the requirement of replacing a radio.

In order to achieve the same transmission performance at 6.7 gHz as at 1.9 gHz, the users will, in all probability, be required to add space diversity antennas to improve multipath availability. The addition of this second antenna will require the addition of a second run of transmission line. The use of high performance antennas due to the increased frequency congestion in the area will also be a requirement in most areas.

This increased tower loading due to the additional antennas and transmission line may, in all probability, require either additional tower modifications or entire tower replacement, including foundations. Since many users lease tower space from other companies, the expense of upgrading or replacing a tower must take into consideration the cost and affect on other users.

In many instances, 1.9 gHz frequency band users with long microwave hops may have to shorten their microwave paths by adding intermediate repeater sites. This may possibly require the construction of completely new communication sites including roads, commercial power, buildings, etc. This may, in itself, prove difficult since local zoning ordnances in metropolitan and rural areas tend to restrict the construction of new towers and sites, especially on U.S. Forest Service and National Park lands.

The attached path calculation sheets indicates the typical performance of a 2.145 gHz microwave path for an industrial user. The microwave path is 60 miles in length and is presently utilizing an analog radio with 24 voice channels. This path currently has a multipath availability of 99.99841% utilizing ten (10) foot grid parabolic antennas at each site.

If this radio path is moved to the 6.7 gHz , or similar, frequency band, the requirement will be not only to change the radio type but to change the antenna sizes to a minimum of a twelve (12) foot and fifteen (15) foot high performance antennas and a change in transmission line type. This change will cause additional tower loading which may require an entire replacement of the tower which increases overall system cost. However, this solution assumes the antenna heights will not require modification to meet the more stringent Fresnel zone clearance criteria of the 6.7 gHz frequency band.

A solution to this problem is the addition of an intermediate microwave repeater site at the half-way point of the path. This repeater site will provide the paths with equivalent path availability compared to the original 2.145 gHz path by using eight (8) foot high performance parabolic antennas at each site. This solution, obviously has an impact on the price of the system since it now requires two 6.7 gHz microwave paths to replace a single 2.145 gHz path.

The estimated cost of providing the above scenarios is indicated in the tables that follow. The net result is the cost of directly replacing the 2.145 gHz radio equipment with new 6.7 gHz radio equipment is a minimum expenditure $286,109.00 while the price of replacing the system with the addition of a new repeater site will be $594,066.00.

EXISTING 60 MILE 2.145 GHZ MICROWAVE PATH